emerged from the water bodies along road on attaining adulthood were common, but is not discussed in this paper.

Overall, more kills occurred during July, comprising mostly of snakes. The kills of snakes occurred after the first showers after the long spell of the dry season. Snakes are more active during this period due to various reasons (Whitaker 1978). Other than accidental kills, we recorded intentional killing of snakes and also birds, such as Grey Junglefowl *Gallus sonneratti* and Greater Coucal *Centropus sinensis* by drivers. Snakes are killed due to the hatred for snakes, while the two bird species are collected for food or killed for fun.

The forest and wildlife of Sriharikota are well protected due to the Island's high security status. However, the wildlife does face problems (Manakadan *et al.* 2004b), one of which is the threat of road kills. Measures are needed to reduce the incidences of road kills through awareness programmes, check on speed limits of vehicles, creation of speed breakers, culverts and installing sign boards at road kill prone areas. Decrease in the extent of the road network (where possible) could also be explored. All these recommendations have been communicated to the authorities of the spaceport in our report.

ACKNOWLEDGEMENTS

We thank the Indian Space Research Organisation for financial support and the authorities in the SDSC-SHAR, Sriharikota, for support and co-operation. We thank J. Patrick David for perusal and comments on the draft.

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4. FACTORS CAUSING NEST LOSSES IN THE PAINTED STORK *MYCTERIA LEUCOCEPHALA*: A REVIEW OF SOME INDIAN STUDIES

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Losses at egg and nestling stages significantly impact fitness in birds and so their assessment becomes critical in developing conservation strategies for endangered species. The near threatened Painted Stork *Mycteria leucocephala* with a stronghold in India is a flagship of wetlands and heronries (BirdLife International 2001). Although recent researches have explored several aspects of its biology, including sexual size dimorphism (Urfi and Kalam 2006), foraging behaviour (Kalam and Urfi 2008), resource partitioning (Istiaq *et al.* 2010), nesting (Urfi *et al.* 2007; Meganathan and Urfi 2009) and habitat ecology (Sundar 2006), a broad based overview of the various biotic and abiotic factors responsible for nest losses in this species is warranted. The present study aims to address this shortcoming.

Biotic factors

Predation on Eggs and Nestlings

Nest predation is the single most important ecological factor influencing reproductive success in birds. Ensuring safety from ground predators, chiefly mammals, has been a strong selective force in the evolution of coloniality in birds (Brown and Brown 2001). Most Painted Stork colonies are either located on islands or on large trees on land and so the impacts of direct predation by land animals is minimized. However, mammalian predators can sometimes reach island colonies by swimming when the water is shallow or a bridge

is formed due to a sudden drop in water level. Pande (2006) records an instance at Bhadalwadi Tank of stray dogs, Common Mongoose *Herpestes edwardsi*, Jackal *Canis aureus* and Wolf *Canis lupus* being able to gain access to Painted Stork nests when the water level surrounding the colony dropped unexpectedly. Although, cases of mammalian predators reaching nesting colonies located on islands in the sea by swimming are probably rare, at Man Marodi island in the Gulf of Kutch, where Painted Stork build nests on *Salvadora*, quite close to ground level, jackals have been reported to prey upon nestlings (Urfi 2003). Reportedly, they arrive on the island by swimming at low tide, from nearby mainland areas. At Ranganthittu Bird Sanctuary, troops of Bonnet Macaque *Macaca radiata* were recorded to swim across the river to the bird colonies on islets and plunder the eggs in the nests (Neginhal 1982). Village heronries such as Kokre Bellur (Neginhal 1977; Nagulu and Rao 1983) or heronries on large trees in city parks, such as gardens in Bhavnagar (Parasharya and Naik 1990) are good examples of safety from ground predators being ensured due to location of nests at a height. The only way in which ground predators can have access to nestlings is when they accidentally fall off from their nests. While the predators in village heronries are mostly feral dogs (Subramanya and Manu 1996) in island colonies they may be the Mugger Crocodile (*Crocodylus palustris*), as in the case of Ranganthittu (Neginhal 1982).

Since most observations on nest losses are based on observations made during the day, the impact of night time predation remains largely unaccounted for. However, some scattered reports confirm its occurrence. For instance, Common Indian Monitor *Varanus bengalensis* climbing on trees and devouring the eggs of Painted Stork in evenings at the Delhi Zoo is one recorded case (Meganathan and Urfi 2009). At Bharatpur, most kills of fledgling Painted Stork by *Aquila* were recorded on moonlit nights (Naoroji 1990).

The main predation pressure is of course exerted by raptors against which there is often no protection. Several points are of interest here. Firstly, in north India at least the period when nests have fledglings is the same time when the influx of migratory raptors begins (Naoroji 1990). Secondly, recent studies at Delhi Zoo and Sultanpur (Urfi *et al.* 2007; Meganathan and Urfi 2009) have hinted of a broad correlation between the body sizes of predator and prey. For instance, while Crow *Corvus splendens* attack small nestlings (<15 days old), Black Kite *Milvus migrans* showed a preference for older nestlings (> 15 days). Thirdly, there are differences in predator species at colonies located in urban areas and those in the country, as would be expected. While at Delhi Zoo, which is located in a large city, omnivorous, birds like crows and kites account for most of the egg and nestling losses, at natural areas like Sultanpur and Keoladeo, those raptors which are partial to undisturbed areas in the country such as Greater Spotted Eagle *Aquila clanga*, Steppe Eagle *Aquila nipalensis*, Imperial Eagle *Aquila heliaca* and Pallas's Fishing Eagle *Haliaeetus leucoryphus* are the main predatory agents (Naoroji 1990; Urfi *et al.* 2007). This therefore leads to the question, since at urban sites predation pressure is lower, compared to colonies in the countryside, could this be an additional inducement for the formation of colonies in urban premises, besides conditions of safety and availability of suitable nesting substrates?

Detailed observations on the mode of attack by *Aquila* spp. are known largely through the observations of Naoroji (1990) at Bharatpur. For instance, only nestlings were taken and adults were seldom attacked. The hunting method of raptors was opportunistic and cases of their trying to bully adults, mostly unsuccessfully, to leave nests were also recorded. Kleptoparasitism among the raptors and often involving crows (*Corvus splendens* and *C.* [*macrohynchos*] *culminatus*) was common. An examination of nestlings attacked revealed that a number of individuals had sustained head and neck injuries, suggesting that most attacks were directed towards the head. Earlier, Lowther (1949) recorded a breast portion of Painted Stork eaten and rest discarded. Interestingly, while at the Keoladeo, nests in isolated patches were observed to be preyed upon as frequently as nests in groups, spatial variations in predation rates were observed at Delhi Zoo (Meganathan and Urfi 2009).

Infertile Eggs

Eggs lying in nests, generally untouched by predators and hence assumed to be infertile, have been recorded at Delhi Zoo and Sultanpur (Desai *et al.* 1977; Urfi *et al.* 2007; Meganathan and Urfi 2009).

Starvation

Starvation is often attributed to be a major cause of nestling loss in birds, especially in the first two weeks post hatching. At the Delhi Zoo the figure of yearly starvation deaths was estimated at around 38% (Desai *et al.* 1977). Although the deceased nestlings were not examined to study body condition and to verify the cause of death, the study noted that competition between the siblings, in which older nestlings monopolized all the food regurgitated by the parents on the nest floor, resulted in the younger siblings losing condition and eventually dying. In some years, notably 1966, 1967 and 1971, the number of nestling deaths, assumed to have been caused due to starvation, was recorded to be 44%,

50% and 55% respectively. Compared to 1968-1970 when such mortalities were below 33%, this is a high number and could be due to shortage of food. However, the authors do not mention if these years were also years of bad monsoon, when food production in the natural wetlands, which is rain dependent, would be expected to be low.

Abiotic factors

Weather

Although the Painted Stork exhibits a wing spread behaviour at nest, typical of genus *Mycteria* (Hancock *et al.* 1992), to shield nestlings from the sun and also regurgitate water to bring down nest temperatures on hot days, no cases of nestling mortalities due to over heating are on record. However, fluctuations in environmental temperatures leading to nestling mortalities in White Stork *Ciconia ciconia* have been reported (Jovani and Tella 2004). It would be expected that for warm tropical environments like India, hypothermia related mortalities would be rare. However, in Delhi, where environmental temperatures in December and January can drop to *c.* 7°C in the night (WWIS 2010) some nestling mortalities can be expected. Indeed, bodies of juveniles and adults (n<5) were observed on days immediately succeeding very cold days during 1988-1992 at the Delhi Zoo (Urfi unpubl. obs). However, since the corpses observed to be strewn on branches of trees close to the nests, were not recovered for a post mortem examination, it could not be ascertained if these deaths were indeed due to hypothermia. Dead nestlings and adults were also observed during the study in 2005-06 (Meganathan and Urfi 2009).

Human factors

Though storks and other heronry birds build colonies in urban premises, they are quite sensitive to human disturbance (Urfi 1990; Datta and Pal 1993; Gadhvi 2002).While many cases of nest losses due to human factors are on record some interesting ones are enumerated below. In Udupuria, nestlings and juveniles were attacked by (honey) bees when a hive on one of the nesting trees was accidentally disturbed by villagers. Twelve nestlings and 23 subadults were found dead, up to 200 m from the colony (Nair 2006). At Bhavnagar, many subadults making their initial flights were recorded to get entangled in the kite strings and get killed. Unfortunately, the timing of kite flying festival in the city coincides with the time when the young are big enough to make the first local flights (Parasharya and Naik 1990). In addition to these, disturbance leading to nest abandonment, either due to the presence of large number of people near the colony or bursting firecrackers (Vashishtha 2001) and putting up scare crows are also on record. At Ranganthittu, if the tourist boats go very near the breeding birds they get frightened and fly away leaving their nests unprotected. The crows anticipating this situation follow the boats and pillage the eggs and even take away the nestlings from the unguarded nests (Neginhal 1982).

ACKNOWLEDGEMENT

I thank the University of Delhi for providing funds under its scheme – 'Strengthen R & D Doctoral Research Programme by providing funds to university faculty' which enabled me to complete this paper.

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5. PARTIAL ALBINISM IN BLACK IBIS *PSEUDIBIS PAPILLOSA*

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Albinism is the absence of the pigment melanin in organisms. Albinism in birds has been classified into four groups (Pettingill 1956). Total albinism is complete absence of melanin; incomplete albinism is lack of pigment either in the plumage, eyes or unfeathered parts, but never all three. In Imperfect albinism melanin is reduced either in the plumage, eyes, or unfeathered parts. Partial albinism is total absence of melanin from only a few feathers; the pigment-free areas may be symmetrical or asymmetrical.

On August 18, 2009, at 11:00 hrs, during our 3-year study at Kharodo between Miyasana and Nandali village, situated in Mehsana district, north Gujarat (23° 55' N; 72° 38' E), 5 km far from Kheralu, we observed asymmetrical partial albinism in a Black Ibis *Pseudibis papillosa* feeding in a small flock. This is the first record of asymmetrical partial albinism in Black Ibis from this area (Fig. 1).

Albinism in birds has been reported in the past: Great-tail Grackle (Phillips 1954), House Wren and Carolina Wren (Ross 1963), Carolina Wren (Seneca 1985), Hooded Crow (Slagsvold *et al.* 1987), Black Drongo (Prasad 2000), and Red-vented Bulbul (Patel 2009).

Total albinism is caused due to complete lack of tyrosinase activity in the organism. Mechanisms leading to partial loss of tyrosinase activity in birds has not been elucidated, but presumably involve mutations or other known mechanisms of gene inactivation.

Fig. 1: Asymmetrical partial albinism observed in a small flock of Black Ibis

The observation that some families of birds are more prone to albinism than others is interesting, but the biological causes underlying these observations remain unclear. Hopefully, continued documentation of aberrant plumages in all families of birds will eventually lead to generation of testable hypotheses to explain these fascinating and striking plumage patterns.

ACKNOWLEDGEMENTS

Financial support from UGC, New Delhi, through a RGNJRF scheme for SC/ST candidates is gratefully acknowledged. We are thankful to Prin. Dr. M.I. Patel for his valuable suggestions. We also thank Prof. R.M. Gohel, Paras Desai and Chirag Patel for their help in field.

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